COMPUTERIZED SYSTEM AND METHOD FOR SIMULTANEOUSLY REPRESENTING AND RECORDING DYNAMIC JUDGMENTS

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefit of U.S. Provisional Application Serial No. 60/270,854, filed February 23, 2001, and U.S. Provisional Application Serial No. 60/292,115, filed May 18, 2001, both of which are fully incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] This invention was made with Government support under SBIR grant Nos. 1 R43 MH62833-01, 1 R43 NS42387-01, 1 R43 HL/MH68493-01 awarded by the National Institutes of Health. The Government has certain rights in the invention.

TECHNICAL FIELD

[0003] The present invention relates to methods for representing and recording personal judgments and more particularly, relates to a computerized system and method for representing and recording dynamic, relative judgments of physical or non-physical concepts in one or two dimensions.

BACKGROUND INFORMATION

[0004] Studies have been performed using cognitive mapping methods to assess a person's conception of the perceived or ideal distances between actual or hypothetical physical objects, such as buildings on a campus or in a town, or the perceived glossiness of images in a photograph. These studies have been done both by physical manipulation of objects (photographic prints), as well as by using a computer system to record the location of objects placed by an individual in a grid appearing on a computer monitor. These studies and methods are described in various publications[1], all of which are incorporated herein by reference.

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[1] Baird, J. C., Degerman, R., Paris, R. & Noma, E. (1972). Student planning of town configuration. *Environment and Behavior, 4*, 159-188.

Nagy, A. N. and Baird, J. C. (1978). Children as environmental planners. Chapter in Altman, I. and Wohlwill, J. F. (Eds.) *Children and the Environment*, Plenum Press, New York, pp. 259-294.

Baird, J. C. (1979). Cognitive representation of spatial relations: I. Overview. *Journal of Experimental Psychology: General, 108*, 90-91.

Baird, J. C., Merrill, A. A. and Tannenbaum, J. (1979). Cognitive representation of spatial relations: II. A familiar environment. *Journal of Experimental Psychology: General*, 108, 92-98.

Merrill, A. A. and Baird, J. C. (1979). Cognitive representation of spatial relations: III. A hypothetical environment. *Journal of Experimental Psychology: General, 108*, 99-106.

Engeldrum, P., & McNeill, G. (1985). Some experiments on the perception of graininess in black and white prints. Journal of Image Science, 29, 18.

Engeldrum, P. (1991). *Print-Quality Requirements*, Proceedings of SID, 32, 141.

[0005] One problem with the methods described in these publications is that they have only been used to scale judgments of objects that are naturally situated in a metric space (buildings) or of physical stimuli that are directly perceived by an observer (photographic prints). These methods are also limited in that they do not provide a precise measure of the rating assigned to each item, because the location of the item along the scale has an error bar equal to the width of the pictorial word or icon. These methods also are limited in that they do not allow for (e.g., in the case of prints), or have not recorded (e.g., in the case of computer methods) dynamic changes of judgments over time.

[0006] Accordingly, a computerized system and method is needed that represents and records the scale values resulting from the dynamic adjustment of the location of multiple concepts in one or two dimensions. A computerized system and method is also needed that allows the user's judgment decisions to be evaluated continuously by recording the changes made in the user's judgments over time.

SUMMARY

[0007] To address the needs described above, a computerized system and method is provided for representing judgments of a user, for recording relative judgments in one or two dimensions,

and for recording the judgment making process. In general, the computerized method displays multiple concept representations simultaneously, receives a user-manipulated adjustment to one or more of the concept representations to create a judgment representation, and records the judgment representation(s) and user-manipulated adjustment(s). The judgment representations and adjustments are preferably recorded continuously so that the judgment process can be reviewed and evaluated.

[0008] In accordance with one aspect of the present invention, the computerized method represents and records relative judgments within a physical context.

[0009] In accordance with another aspect of the present invention, the computerized method represents and records relative judgments along a one-dimensional scale.

[0010] In accordance with a further aspect of the present invention, the computerized method represents and records relative judgments along a two-dimensional scale.

[0011] In accordance with a further aspect of the present invention, the computerized method represents and records relative judgments using a polar coordinate scale.

[0012] In accordance with a further aspect of the present invention, the computerized method represents and records relative judgments by associating concepts without any physical context or scale.

[0013] In accordance with yet another aspect of the present invention, the computerized method represents and records relative judgments using the above methods together with a fixed resource technique.

[0014] The computerized system preferably implements the methods defined above using software and a computing device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] FIGS. 1 and 2 are schematic block diagrams of the computerized system for representing and recording judgments, according to different embodiments of the present invention;

[0016] FIG. 3 is a flow chart illustrating a method for representing and recording judgments in a physical context, according to one embodiment of the present invention;

[0017] FIGS. 4, 4A and 5 are illustrations of a human form for indicating pain locations, according to one example of the method for representing and recording judgments in a physical context;

[0018] FIG. 6 is a flow chart illustrating a method for representing and recording judgments in relation to a rating scale, according to another embodiment of the present invention;

[0019] FIG. 7 is a graphical illustration of a vertical rating scale with unrated concept representations corresponding to various types of pain, according to one example of the method

for representing and recording judgments in relation to a rating scale;

[0020] FIG. 8 is a graphical illustration of the vertical rating scale shown in FIG. 7 with the concept representations positioned relative to one another and rated based on the location relative to the rating scale;

[0021] FIGS. 9 and 10 are graphical illustrations showing a vertical scale with concept representations corresponding to emotional feelings, according to another example;

[0022] FIGS. 11-14 are graphical illustrations showing a horizontal rating scale with concept representations, according to further examples;

[0023] FIG. 15 is a graphical illustration of a horizontal rating scale with each of the words in a different row, according to yet another embodiment of the present invention;

[0024] FIGS. 16-17 are graphical illustrations of a two dimensional scale with concept representations, according to yet another example;

[0025] FIG. 18 is a graphical illustration of a two dimensional polar coordinate scale with concept representations, according to yet another example;

[0026] FIG. 19 is a flow chart illustrating a method for representing and recording judgments by associating concept

representations in space, according to a further embodiment of the present invention; and

[0027] FIG. 20 is a graphical illustration of concept representations associated in space, according to one example.

pictures or some other icon (such as a solid geometric figure). The concepts can be any physical item (e.g., food) or non-physical concept (e.g., feelings or issues) about which a user can express judgment. Using the user input 16 (e.g., by depressing the mouse button), the user represents one or more relative judgments by locating concept representations in the space relative to other concept representations, a physical context, and/or a scale. The system can receive user-manipulated adjustments of the concept representations relative to each other, the physical context, and/or the scale. In response to the user's manipulation of the concept representation(s), the system draws the concept representation at its user-designated location, such as occurs when icons are moved across the screen in computer operating systems.

[0031] The system thus allows the users to dynamically express and/or modify their relative judgments, for example, by positioning the concept representations relative to one another, relative to a scale, and/or relative to a physical context on the computer screen. The sequential order and value of each manipulation and adjustment is recorded, together with the time required by the user to make the adjustment. The user continues locating concept representations on the screen or continues making adjustments of all concept representations until satisfied with the judgments represented. When the user is

satisfied, the user signals (e.g., by pressing any key on the computer keyboard), and the system then records the final values of the judgment representations. Various methods of the present invention are described in greater detail below.

[0032] One method of representing and recording judgments in relation to a physical context is illustrated in FIG. 3. According to this method, at least one physical context representation is displayed, step 112. The physical context representation represents the physical context (e.g., the user's body) in which the user is making judgments, and the user is asked to make a judgment by designating locations (e.g., a pain location) in the physical context. The system then receives the user input judgment associated with at least one location in the physical context, step 116. The location representing the user's judgment is then displayed in relation to the physical context representation, step 120. User input information (e.g., each user designation and the time between designations) is recorded as each of the locations are designated by the user, step 124. The user can adjust or modify the judgment representations, step 128, for example, by designating new locations and/or erasing existing designations. The user input information for these adjustments is also recorded. When the user is finished, the final judgment representations are recorded, step 130.

[0033] Referring to Fig. 4, one example of the method of representing and recording judgments in relation to a physical context is described in greater detail. According to this exemplary method, the user is a patient experiencing a sensory symptom such as pain or itchiness, the physical context is the patient's body, and judgments pertaining to the location of the symptom are recorded. The system displays outline drawings 30 of a human head and body, and the user locates the cursor at one or more locations 32a, 32b on the figure to indicate the pain or itchiness or some other sensory symptom.

[0034] Depressing the mouse results in the appearance of a solid figure (square, circle, or some other geometric figure) at that location. The size of the figure can be adjusted to accommodate the size of the entire drawing as it appears on the computer screen. By holding down the mouse button and moving the cursor, the user can fill in a region on the drawing or indicate the exact pattern of locations on the body where the symptom is experienced. The system preferably only places points that do not overlap with adjacent points so that the system does not have multiple records of the same (or almost the same) placement location. A library of "legal" points (i.e., those falling within the confines of the figure) can be stored separately, and checked by the software before displaying a point indicated by the user. The user can also erase any

inadvertent designations. Different colors or types of geometric figures can be used to represent different types of sensory symptoms (e.g., different types or intensities of pain) in a physical context. In one example shown in FIG. 4A, patients can record their symptoms at different intensities on the body picture using different colors to represent the different intensities (as indicated by the scale), thereby providing a symptom scanning technique.

[0035] The system records the order of each point's placement on the drawing, for example, by recording the x,y coordinates of each point placed on the drawing. The system also records the times between each designation of a point on the drawing. This data allows an investigator to exactly reproduce the judgment process employed by the user in marking locations on the figure. The recorded judgment data and judgment process data can thus be used to evaluate the patient's condition. In one example, an animated graphical representation showing the judgment process can be replayed (e.g., as a movie) to visualize the exact manner in which the user made each judgment. In another example, the data can be compared to previously recorded data for other patients, which has been stored in a library of data, to give a likely diagnosis for consideration by the physician.

[0036] According to one variation of this method for representing and recording judgments of sensory symptoms, as

shown in FIG. 5, multidimensional judgments pertaining to the symptoms at each user-designated location can be represented and recorded. For example, a graphical representation 34 associated with a user-designated location can be displayed to allow the user to make the multidimensional judgments further characterizing the symptoms. Examples of methods for representing and recording multi-dimensional judgment representations (e.g., using a fixed resource technique) are described in greater detail in co-pending provisional application Serial No. 60/270,854 (Attorney Docket No. BAIRD-001PR) and application Serial No. 09/950,126 (Attorney Docket No. BAIRD-001XX), both of which are incorporated herein by reference. Other methods for representing and recording judgments to further characterize the symptoms include the methods described in greater detail below.

[0037] One method of representing and recording judgments in relation to a rating scale is illustrated in FIG. 6. According to this method, multiple unrated concept representations are displayed (e.g., using words, pictures or icons), step 222. The concepts can be physical or non-physical and can include anything about which a user can express a judgment. One or more rating scales are also displayed, step 226. The rating scale(s) provide a range of possible judgments applicable to the concepts (e.g., degrees of pain). The user is asked to make a judgment

rating each of the concepts in relation to the rating scale(s) and in relation to one another, for example, by manipulating and locating the concept representations along the rating scale(s). When the user input rating of a concept is received, step 230, the concept representation is displayed in relation to the scale, step 234. User input information is recorded as the user rates (or adjusts the rating of) each of the concepts, step 238. If the user wants to rate another concept or adjust a rating, step 242, these steps are repeated. When the user is satisfied, the final ratings are recorded as the user's judgment representation, step 246.

[0038] Referring to FIGS. 7-17, examples of the method of representing and recording judgments in relation to a rating scale are described in greater detail. As shown by example in FIG. 7, words initially appear in a vertical list 40 on the screen and a single linear scale 42 appears on the screen with numerical values (e.g., integers 1 to 10) and tick marks. The scale 42 can be oriented either vertically (FIGS. 7-10) or horizontally (FIGS. 11-15). The user moves the words (i.e., the concept representations) to positions along the scale 42 to indicate an amount or degree along the dimension, thereby representing the user's judgment by rating the concept. In one example, the movement is accomplished by positioning the cursor on the word, clicking on the mouse, and moving the cursor. The

system automatically erases the old representation of the word and draws it in the new location. This occurs continuously as the cursor is moved.

[0039] When a concept representation is manipulated, an indication is preferably displayed on the rating scale indicating the user input rating. For example, the movement of a single word along the scale 42 leads to a corresponding change in the position of an arrowhead 46 that slides along the scale 42 and points to the exact rating at each instant in time. The words can appear at any position along the dimension of the computer screen that is orthogonal to the orientation of the measurement scale 42, thus allowing different items to receive the same ratings. For example, the words can be located in separate rows above the horizontal scale 42', as shown in FIG. 15, so that more than one concept can be given the same rating without the words overlapping. In the case of a vertical scale, the words can be located adjacent to each other, within the limits of the screen size.

[0040] As additional words are added to the scale 42, the user rates the words with respect to the scale and relative to the other words already rated. The method allows the user to continue manipulating the positions of the words until the user is satisfied with all the ratings. The user input information recorded includes each move, the order for each move, and the

time required for each move. In one example, the user input information is stored as an animated graphical representation, which can be replayed to visualize the exact process of making each judgment.

[0041] In the example illustrated in FIGS. 8 and 12, a patient in chronic pain adjusted the adjectives to indicate the appropriateness (Least to Best) of each adjective for describing the character of the patient's pain. The adjective "throbbing" was rated as the most appropriate and the adjective "tender" was rated as the least appropriate. The advantage of this method over the standard means of obtaining ratings for each adjective in isolation is that judgments are made within a "context" of other adjectives, thus encouraging the user to make distinctions among the adjectives in terms of their ratings. In the standard method when adjectives are rated in isolation in the clinic, chronic pain patients tend to choose high ratings of appropriateness or intensity for all the adjectives. In another example illustrated in FIGS. 10 and 14, the patient used the adjectives to describe the patient's feelings.

[0042] According to another example, shown in FIGS. 16-17, concept representations are located by the user along two dimensions simultaneously. As shown by example in Fig. 16, words initially appear in a vertical list 40 on the screen and a two-dimensional, orthogonal coordinate system (e.g., vertical

rating scale 42 and horizontal rating scale 42') is shown with tick marks and integers designating different levels of the attribute being judged. The user moves the words (i.e., concept representations) to positions within the two-dimensional space relative to the vertical scale 42 and the horizontal scale 42'. This movement of the representation is linked in a linear fashion to movement of one arrowhead 46a along the vertical scale 42 and of another arrowhead 46b along the horizontal scale 42'. The system allows the user to continue manipulating the positions of the items in two dimensions until they are satisfied with all the ratings along both scales 42, 42'. The system records the concept ratings and movements on both scales 42, 42', the order for each move, and the time required for each move.

[0043] In one example, the user may not assign exactly the same ratings (x and y coordinates) for two or more items because this requires that the two words be placed on top of each other, thereby making them unreadable. According to another example, a three-dimensional scale can be used with each of the words located and movable in its own plane above the ground plane including the two-dimensional scale. When each of the words is moved, the x, y location is displayed on the ground plane relative to the two-dimensional scale. This three-dimensional example allows multiple words to have the same rating (i.e., the

same x, y location) without the words having to be placed on top of one another.

[0044] In the example illustrated in FIG. 17, a hypothetical user expressed their preference (vertical scale) and perceived nutritional value (horizontal scale) of different foods. The item "pasta" was rated as well liked and of high nutrition; the item "water" was rated as well liked and low in nutrition; the item "broccoli" was rated as poorly liked and high in nutrition; and the item "lettuce" was rated as poorly liked and low in nutrition.

[0045] Alternatively, the two dimensional scale can be represented as a polar coordinate system 50, as shown in FIG. 18. The user moves the concept representations 52 (e.g., words, letters, pictures or icons) within one or more circles 54 to different locations in the space. The value measured along one dimension (e.g., preference) is the distance of the item from the center 56 of the circle(s) 54. The value along the second dimension (e.g., nutritional value) is the angle of a vector extending from the center 56 of the circle(s) 54.

[0046] According to another method of representing and recording judgments, as shown in FIG. 19, concept representations are positioned relative to one another in two dimensions without any physical context or rating scale. Multiple concept representations (e.g., words, pictures, or

icons) are displayed, step 322. The user is asked to make judgments by manipulating the concept representations and moving the concept representations in relation to one another. The user manipulations of the concept representations are received, step 326, and the concept representations are displayed at the user-designated location, step 330. User input information is recorded as each concept representation is manipulated, step 334. These steps can be repeated to adjust or modify the user's judgment, step 338. When the user is finished, the final positions of the concept representations representing the user's judgments are recorded, step 342.

[0047] One example of this method of positioning concept representations 60 in two-dimensional space is used with food items, as shown in FIG. 20. The user locates the food items in two dimensions on the computer screen by moving words to positions relative to each other. No scales or units of measure are shown and the user is not told what the two dimensions of the screen represent. The user is instructed to adjust the items such that those items that go together (specific attributes can be specified) are close together in space and those items that do not go together are far apart in space. The inter-item distances can later be analyzed so that items are placed in either clustered groupings (non metric) or in a two-dimensional coordinate system (metric). The advantage of this

method over previous manual and computer applications is that one can store a running record of every keystroke made by the user in rendering judgments as items are moved about the screen.

[0048] According to further embodiments of the present invention, any of the methods described above can incorporate the fixed resource technique, as described in greater detail in co-pending provisional application Serial No. 60/270,854 (Attorney Docket No. BAIRD-001PR) and application Serial No. 09/950,126 (Attorney Docket No. BAIRD-001XX), both of which are incorporated herein by reference. For example, a horizontal scale 42′ (for example, as shown in FIG. 15) can be used with each word (or other type of concept representation) located in its own row above the scale 42′. As one word is moved horizontally in relation to the scale 42′, one or more of the other words are able to move automatically without interfering with one another in accordance with the fixed resource technique. The three-dimensional scale described above can also be used according to this embodiment to provide the fixed resources in two dimensions.

[0049] Accordingly, the system and method of the present invention is able to dynamically represent relative judgments while also recording the judgment process. Modifications and substitutions by one of ordinary skill in the art are considered

to be within the scope of the present invention, which is not to be limited except by the following claims.